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RESEARCH TRIANGLE INSTITUTE

QUARTERLY PROGRESS REPORT

Contract No. NAS5-26442

A Study of Model Parameters Associated With the Urban Climate Using HCMM Data

Project Leader: Fred M. Vukovich

Geosciences Department

Research Triangle Institute
P. O. Box 12194
Research Triangle Park, NC 27709

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Prepared for

The National Aeronautics & Space Administration
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1.0 Introduction

The Research Triangle Institute (RTI) is using infrared and visible data from the Heat Capacity Mapping Mission (HCMM) satellite to study the intensity of the urban heat island, commonly defined as the temperature difference between the center of the city and the surrounding suburban and rural regions, as a function of changes in the season and changes in meteorological conditions in order to derive various parameters which may be used in numerical models for urban climate. The analysis is focused on the city of St. Louis; and *in situ* data from St. Louis will be combined with HCMM data in order to derive the various parameters. The following are research tasks which we performed in order to meet the overall objective:

1) Determine specific case studies and obtain HCMM data and *in situ* data for each case study.

2) Establish ground temperatures using HCMM data corrected for the effects of atmospheric absorption.

3) Compare the corrected and uncorrected HCMM data to determine the magnitude of the error induced by atmospheric effects.

4) Compute the friction velocity, the Monin-scale temperature, the Monin-scale length, the surface roughness, and the eddy exchange coefficient using the HCMM *in situ* data.

5) Compute the heat island intensity using both HCMM ground temperature and *in situ* surface air temperature.

6) Determine estimates of anthropogenic heating using a boundary-layer model and parameters developed in Tasks 3) and 4).

2.0 Progress to Date

All HCMM CCT's, which were ordered for the dates given in the Progress Report dated April 1981, have been received except for the data for 10 June 1978. The 10 June data have been reordered and should be available to RTI within the next month.

Based on careful analysis of the HCMM imagery and of the CCT's, the final selection of case studies were made. The case studies which will be analyzed are

9 June 1978	26 June 1978
10 June 1978	26 February 1978
14 June 1978	27 September 1979.

The portion of the data on the CCT's for St. Louis have been retrieved for each case study for which tape data are presently available at RTI. Meteorological data for the case studies were reduced and those parameters necessary to describe the atmospheric effect were obtained. The ground temperature analysis for 9 June 1978 has been completed.

The HCMM data for 9 June 1978 were mapped onto a Mercator projection map of St. Louis. For the data on the Mercator map, corrected and uncorrected ground temperature have been computed and analyzed. A comparison of the uncorrected and corrected ground temperatures for 9 June has been completed. This analysis has shown that the average difference between the corrected and uncorrected data is approximately -9.8°C. Using the meteorological data and Mississippi river temperatures, it was determined that the difference between the equivalent back body temperature measured by the HCMM, and the actual ground temperature, should be approximately -4.4°C. This left a difference of -5.4°C unaccounted for. The unaccounted for -5.4°C is equivalent, taking into account the potential errors, to the -5.5°C that the HCMM data were reduced as a result of a calibration performed soon after the launch of the HCMM satellite.

Analyses of the surface air temperature and winds at the 10-meter level have been completed for 9 June 1978 using various data obtained from sources such as the St. Louis County Air Pollution Control Agency, the City

Air Pollution Control Agency, the East St. Louis Air Pollution Control Agency, various universities, and the National Weather Service. These analyses, combined with the HCMM ground temperature analyses, have demonstrated that there was a strong heat island in the city of St. Louis on 9 June, and that the wind field was markedly affected by the heat island.

3.0 Problem Areas

No major problem areas developed during this quarter.

4.0 Work for Next Quarterly Period

During the next reporting period, the analysis of the HCMM ground temperatures will be completed for the data we have presently at RTI. This will include mapping the data onto a Mercator projection map for the city of St. Louis, computing uncorrected ground temperatures, computing corrected ground temperatures, computing the difference between corrected and uncorrected ground temperatures, determining the atmospheric effect from meteorological data and Mississippi temperatures, and comparing the atmospheric effect with the average difference between the corrected and uncorrected HCMM temperatures.

An algorithm which computes the friction velocity, the scale temperature, the Monin length, the heat flux, the surface roughness, and the exchange coefficients will be completed. This algorithm will require the HCMM ground temperatures, surface-air temperatures and the surface winds for inputs, and uses standard boundary-layer theory to make the computations. The algorithm has been named Boundary Layer.

Another algorithm will also be completed which will compute the moisture deficit between the ground and the air. This algorithm is based on the energy balance at the surface of the earth. The algorithm uses HCMM

ground temperatures, surface air temperatures, surface winds and the output of boundary layer to determine the moisture deficit.